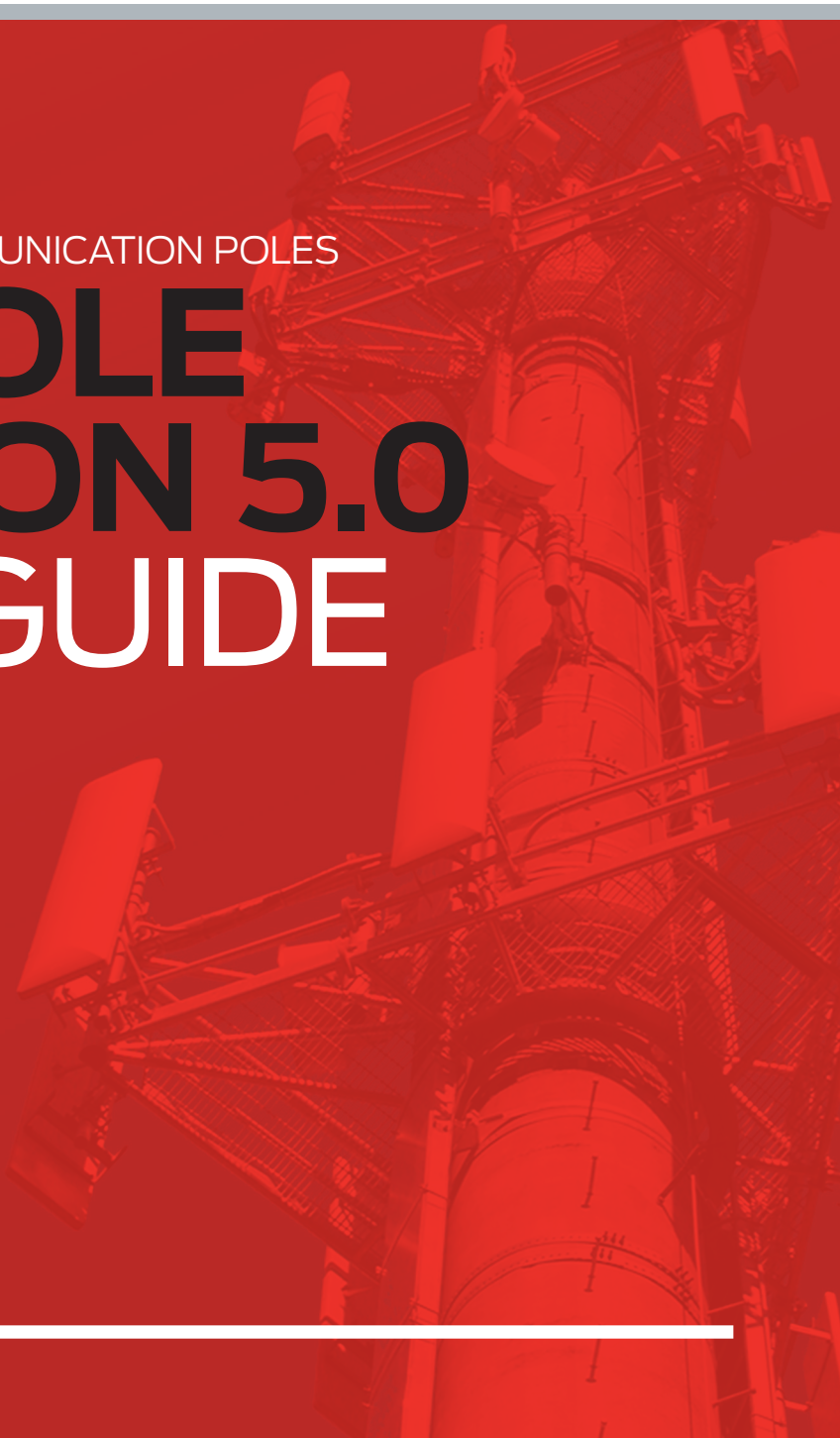
ROCLA DURASPUN COMMUNICATION POLES

ROCPOLE VERSION 5.0 USER GUIDE



USER GUIDE ISSUE: UG1

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Introduction

Rocla has been designing and manufacturing spun concrete poles for over fifty years. The development work resulted in the establishment of Rocla Duraspun® concrete poles.

The Duraspun® trademark represents a collection of processes developed by Rocla to create durable concrete poles: spun concrete combined with accurately made reinforcement cages (from Rocla designed machines) and various other manufacturing processes developed by Rocla.

The design methodology and performance characteristics of Rocla Duraspun® poles were established in conjunction with extensive load testing. The design methodology is based on rational and sound engineering principles. The Rocla in-house design methodology is confidential due to the proprietary information developed by Rocla.

Rocla Duraspun® poles are manufactured under a 3rd party certified Quality Management System that meets the requirements of ISO9001:2008.

Communication poles are typically required to support a wide range of antennae configurations and have high rotation resistance under Serviceability wind loads as well as satisfying ultimate strength requirements. Rocla Duraspun® Communication poles are inherently capable of satisfying these requirements.

Rocla Duraspun® Communication poles are:

- Designed and manufactured to satisfy structural and durability requirements.
- Provide a cost effective installed pole.
- Can be supplied with various accessories and fittings, e.g. cable entry openings, tip ferrules, etc.
- Direct pole embedment for low foundation cost.
- Can accommodate different types of foundations for different soil conditions.
- Inherently stable in resisting dynamic wind loads and vibrations.
- Quick and easy to install.
- Fire proof and long service life.
- Are locally supplied and supported for quick response to customers and installers.
- All poles are extendable via a bolt-on steel turret using tip ferrules cast into the top end of the pole or can have a clamped connection.

Engineering support, Pole Certificates and foundation designs are also available.

The standard Rocla Duraspun® Communication pole ranges include SR, LT and EX poles:

- SR poles are ‘heavy duty’ types, catering for high loads and large sail areas.
- LT poles are slimmer, and are designed for less heavily loaded applications.
- EX poles can be extended with a 5 metre long concrete pole section bolted to the top end.

Changes from RocPole™ Version 4 to Version 5

RocPole™ V4.0 and earlier versions were based on:

- Assumed maximum expected pole deflections.
- Assumed footing rotations.
- Assumed “point of fixity” in the foundation.
- Assumed attachment masses.
- The pole, not the attachments, was considered in the dynamic response to wind loads.

Also, there was much uncertainty in the wind “co-efficient of drag” values adopted for both pole and attachments.

These assumptions were practical and necessary in previous times. A Strength Reduction Factor (SRF) = 0.9 was applied to the ultimate pole strength to provide a greater degree of structural certainty.

RocPole™ V5.0 achieves greater load certainty by:

- Calculating pole deflections for each particular site.
- Adopting footing rotations relevant to the particular site.
- Calculating loads with actual attachment masses.
- Considering the dynamic response of both “pole and attachments” to wind loads.
- Adopting more accurate “co-efficient of drag” values for pole and attachments.

The higher certainty of design loads allows Rocla to offer customers the use of a SRF = 1.0 with RocPole™ V5.0.

The RocPole™ V5.0 software is accessed by approved users via the Internet Web site: https://rocpole.rocla.com.au

Any changes to the software will be immediately available to all users.

Users can run and save site analysis for re-use and future reference.

Accessories and Fittings

A range of accessories and fittings are available, including:

- Step ferrules and associated step bolts.
- Stainless steel ferrules and stainless steel hole-formers to allow bolted connections.
- Fixtures to accommodate climbing and anti-fall systems (e.g. Lad-Saf climbing system).
- Hatch doors and cable entry/exit openings to provide cable access to and from the pole.
- Pole caps.
- Tip ferrules.
- Earthing ferrules.

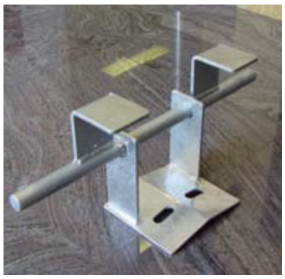
All Rocla Duraspun® Communication poles are identifiable by a small rectangular name plate located either 1.5m above the ground line or 1.5m above the butt end of a pole section. The name plate describes the place of manufacture, pole type, pole/section length, pole/section mass, carrier and date of manufacture.

Poles can also be painted when required.

Accessories and Fittings (continued)

M-12 Earth Ferrule

M-16 Step Ferrule



Bolt-on Ladder Bracket

600x300mm Cable Entry Port

Hold-down Bolt Assemblies

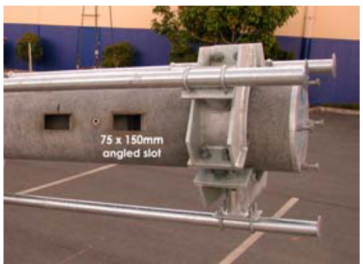
Tip Ferrules

Cable Exit Hatch

Pole Painting

Lad-Saf Cable Guide

M-16 Earth Ferrule



75x150mm Cable Exit Slot

Lad-Sad Bottom Anchor

Jointing Spanner

Joint Lug Assembly

Jointing Epoxy

Definitions

TERM	DEFINITION
AGL	Above ground level
C_d	Co-efficient of drag
EX	Extendable range
G	Dead load = pole weight + attachment weight
GL	Ground level
LT	Light (low strength) pole
M_c	Effective bending moment strength
M_o	The over-turning moment acting on the footing at ground level
M_o(max)	Maximum value of M_o
M*	The sum of applied bending moments acting on the pole
M_s	The sum of the primary bending moments acting at a particular location on the pole
M_s(max)	Maximum value of M_s
M_u	Ultimate bending moment strength
ØM_u	Design bending moment strength
N_{tf}	Tensile strength of a bolt
OD	Outer diameter
'Point of Fixity'	The distance below ground level to the point of maximum bending moment in the foundation
SBM	Secondary bending moment generated from offset vertical loads via pole deflection and footing rotation
SR	Strength rating of pole
V*	Design shear force (Serviceability or Ultimate Limit State)
V_u	Ultimate shear strength
ØV_u	Design shear strength
W_u	Ultimate wind load
Ø	Strength Reduction Factor (SRF)
ULS	Ultimate Limit State
WLL	Working Load Limit (for lifting devices)

User Inputs

The RocPole™ V5.0 software allows the user to select a Communication pole for a particular site or to check an existing pole. However, the user must be suitably knowledgeable and experienced to capably use the program and this User Guide.

The user must enter all the data relevant to a particular site.

To accurately calculate the total bending moment on a pole, the secondary bending moments due to pole deflection and footing rotations are required. RocPole™ V5.0 calculates the pole deflections for the particular site but assumes footing rotations:

Under Serviceability loads, the footing rotation is assumed to be 0.2 degrees at ground level.

Under Ultimate Limit State loads, the footing rotation is assumed to be 5 degrees at ground level.

The expectation is that these footing rotations are conservative. The selected pole size should not need to be changed after the subsequent foundation design is completed. If a refined foundation calculation is required (e.g. to maximize the loading capability of a pole) then this can be undertaken once the geotechnical data is obtained.

As a guide, when a pole has an ultimate loading above 90%, an accurate footing rotation calculation should be undertaken using the site geotechnical data.

The mass of the attachments are required to the nearest 10kg. These masses are to be included in the loading calculations.

The software assumes a nominal sized headframe at the top of the pole when considering the dynamic response of both the “pole and attachments” to wind loads.

Strength Reduction Factor, SRF

The higher certainty of design loads allows Rocla to offer customers the use of a SRF = 1.0. This will only be available to new poles made after the 9th December 2014 and analysed to RocPole™ V5.0. Adopting a SRF = 1.0 allows a higher degree of pole utilization.

The user can prefer to adopt the more conservative SRF = 0.9 for new poles. The SRF choice is either 0.9 or 1.0 for new poles.

A SRF = 0.9 is the default for all existing poles.

When adopting a SRF = 1.0, it is recommended that the user obtain an Installation and Foundation certificate from the pole installer on the completion of the work. This will help ensure the assumed quality of construction and foundation assumptions are consistent with achieving the higher degree of certainty associated with a SRF = 1.0.

Co-efficient of Drag

The “effective sail area” of an attachment includes a co-efficient of drag.

The “co-efficient of drag” values for “pole only” are calculated to AS1170.2 Section E3.

The “co-efficient of drag” value for “pole and cable tray” is dependent upon the horizontal dimension ‘T’ between the pole surface and the furthest point of the tray as viewed side-on in the vertical. The effective sail area = 1.2 x (pole diameter + T) m^2 per metre length. For a second cable tray, effective sail area = 1.2 x (pole diameter + 2T) m^2 per metre length.

The effective sail area for “step bolts and Lad-Saf fall-arrest cable” = 0.03 m^2 per metre length.

The effective sail area for “Ladder and Lad-Saf fall-arrest cable” = 0.14 m^2 per metre length, assuming a 50mm width stile.

These are default values. If a user requires different values to be used, contact Rocla.

Otherwise, the effective sail areas of all other attachments are to be determined by the user.

Design Information

Design Basis

The basic design criteria for V5.0 Communication poles are:

- The Serviceability wind speed is 28 m/s unless stated otherwise.
- The maximum allowable pole tip rotation under Serviceability wind loads is required to be 1.0° (the sum of 'pole rotation' and 'footing rotation') unless stated otherwise.
- Wind load calculations are to AS/NZS1170.2:2011 Structural design actions, Part 2: Wind Actions.
- The critical Ultimate Limit State load combination is: $1.1G + W_u$ (G is the dead load from pole and attachment masses).
- Secondary bending moments (SBM's) due to pole deflection and footing rotation are taken into account.
- Secondary bending moments (SBM's) due to the mass of attachments to the pole are taken into account.
- The dynamic effects of pole attachment masses under wind loads are taken into account.
- The pole design bending strength $ØM_u = Ø \times Mu$ (where Ø = 0.9 or 1.0 under limited conditions). 0.9Mu is the standard reference strength.
- M* to be less than ØMu.
- Calculations are based on the standard Rocla design basis.
- The minimum spun concrete strength, f'c = 65 MPa.
- AS/NZS4065:2010 is the manufacturing standard. AS3600:2009 is not generally relevant.
- Exposure Classifications A1, A2 and B1 to AS3600:2009 for a minimum design life of 50 years.

Tip Fittings and Tip Strengths

The following information relates to the structural strength at the tip end of Rocla Communication poles. It should be noted that the strength may be limited by the fittings, the connecting bolts, the pole crushing strength or the steelwork employed.

LT Type Poles

The tip end of each LT type pole has 4 No M16 tip ferrule assemblies. The tip bending strength of these poles depends upon:

Pole Type	Pole Tip Diameter (mm)	Tip ØMu (kNm)		
		Pole only	Grade 4.6 M16 bolts	Grade 8.8 M16 bolts
LT-A	315	35	17	35
LT-B	360	45	20	42
LT-C	390	70	22	48

Table 1 – Tip bending strengths for LT poles

Notes:

'Tip ØMu' = the design bending strength of the pole at the tip, based on the Grade of bolt used in the ferrules or "pole only" when independent of the ferrules. A phi factor Ø = 0.8 has been applied in these calculations. The lower strength option controls the adopted ØMu.

The bending strengths shown above which involve bolts assume the attached steelwork is sufficiently stiff to adequately transfer the bolt loads. The concrete bearing surface limits the loads in the bolts.

The 4 No tip ferrules are equally spaced on a PCD = Tip OD – 70mm. The tip ferrule orientations are shown in drawing 90779.

The tensile strength of each M16 tip ferrule is limited by the tensile strength of a M16 Grade 8.8 bolt. For reference only:

- The design tensile strength of M16 Grade 4.6 bolts, Ø x N_{tf} = 50 kN (Ø = 0.8)
- The design tensile strength of M16 Grade 8.8 bolts, Ø x N_{tf} = 104 kN (Ø = 0.8)

Refer to drawing 94068 for shear strength values of single tip ferrules under different load directions or as a group.

For loads applied at and above the pole tip end, the bending moments created in the pole beyond the tip end are checked against the bending strengths saved within the software.

SR and EX Type Poles

The tip end of each SR and EX Type pole has 4 No M24 tip ferrule assemblies. The tip bending strength of these poles depends upon:

Pole Tip Diameter (mm)	Tip ØMu (kNm)		
	Pole only	Grade 4.6 M24 bolts	Grade 8.8 M24 bolts
450	110	54	110
525	130	65	130
540	140	68	140
600	160	78	160
615	170	80	170
675	180	90	180
690	185	90	185
750	200	100	200
765	210	105	210
825	250	115	240
840	260	115	245
900	300	125	270
915	310	130	275
990	350	140	300
1050	400	150	320

Table 2 – Tip bending strengths for SR and EX poles

Notes:

'Tip ØMu' = the design bending strength of the pole at the tip, based on the Grade of bolt used in the ferrules or "pole only" when independent of the ferrules. A phi factor Ø = 0.8 has been applied in these calculations. The lower strength option controls the adopted ØMu.

The bending strengths shown above which involve bolts assume the attached steelwork is sufficiently stiff to adequately transfer the bolt loads. The concrete bearing surface limits the loads in the bolts.

The 4 No tip ferrules are equally spaced on a PCD = Tip OD – 80mm. The tip ferrule orientations are shown in drawing 90779.

The tensile strength of each M24 tip ferrule is limited by the tensile strength of a M24 Grade 8.8 bolt. For reference only:

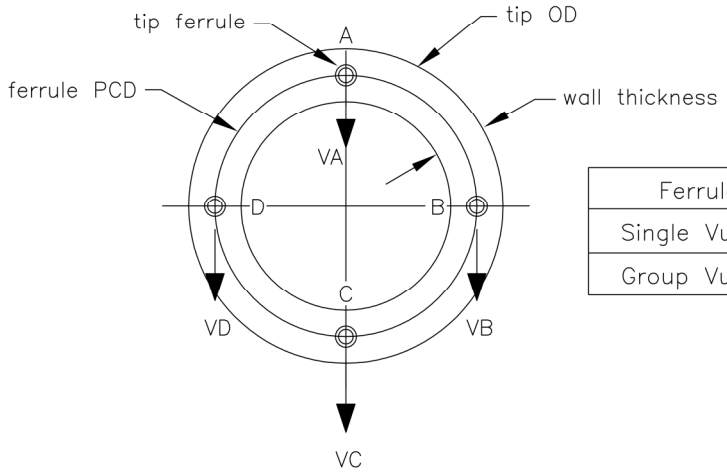
- The design tensile strength of M24 Grade 4.6 bolts, Ø x N_{tf} = 113 kN (Ø = 0.8)
- The design tensile strength of M24 Grade 8.8 bolts, Ø x N_{tf} = 234 kN (Ø = 0.8)

Refer to drawing 94068 for shear strength values of single tip ferrules under different load directions or as a group.

For loads applied at and above the pole tip end, the bending moments created in the pole beyond the tip end are checked against the bending strengths saved within the software.

EX Type poles are designed to accommodate a 5m long concrete extension at the tip end.

Shear Strength of Tip Ferrules



Ferrule	A	B	C	D
Single Vu (kN)	0	35	15	35
Group Vu (kN)	90			

The above shear strength (Vu) values apply to both LT poles (M16 tip ferrules) and SR poles (M24 tip ferrules). The recommended “strength reduction factor” for tip ferrule shear strength = 0.7. Design rule 9.3.3.3 of AS4100 for combined shear and tension should be followed.

- “Single Vu” = minimum ultimate shear strength for a single ferrule in the direction shown. VA = Vu for ferrule A, etc.
- “Group Vu” = minimum ultimate shear strength for the group of four tip ferrules loaded in any direction. E.g. all ferrules connected via a steel plate.

Refer to drawing 94068 for more information.

Pole Foundations

Rocla Duraspun® Communication poles can utilise a number of different foundation solutions depending on the soil conditions [reference drawing in brackets]:

- Direct embedment (standard installation for most ground conditions); [89104].
- Pad footings for rocky ground or poor soils; [90749].
- Hybrid, collared direct embedment type of installation; [90949].
- Driven concrete pile; [92303].

The pole either includes the footing portion (H poles) or is base-mounted at GL (BM poles).

For H poles, the nominated embedment depth for each pole size (refer to GA drawings) represents the difference between pole length and height above ground. These embedment depths are intended to suit normal types of soils. However, when the foundation designer requires a deeper embedment depth, a longer pole may be possible or a cast extension could be undertaken on site.

For saline ground water conditions, the butt of the pole should be sealed to prevent water ingress into the pole. Other protective measures may also need to be considered.

RocPole™ V5.0 achieves greater load certainty by calculating pole deflections and including footing rotations for each particular site. The RocPole™ V5.0 default footing rotations at GL are:

- Under Serviceability wind loads, 0.2 degrees.
- Under ULS wind loads, 5 degrees.

If the geotechnical data for a particular site leads to significantly different footing rotation values then a revised pole analysis should be performed.

Horizontal footing displacement is small relative to the above GL pole displacements and can be ignored when considering SBM's.

Foundation Design Principles

Foundation design is a specialist field requiring geotechnical knowledge and is not addressed in detail in this manual.

It is recommended that all Communication poles have a foundation design completed that is relevant to the particular site. Rocla offer an in-house footing and foundation design service. Please contact your Rocla representative for further information.

Pole foundations need to resist over-turning moments and shear forces under both Serviceability and Ultimate Limit State conditions. Vertical forces must also be taken into account.

The primary factors in the design of “direct embedded” foundation designs are:

- Over-turning moment at ground level.
- Shear force at ground level.
- Embedment depth.
- Foundation width or diameter.
- Soil strength.
- Pole bending and shear strength below GL.

The hole diameter is normally the foundation width when the backfill material is significantly stronger that the immediate founding material. This is the case for Communication poles because, to minimise pole rotation, concrete backfill is typically used.

Over-turning Moments

Tables 3 to 6 provide the maximum M_o values for each pole type. For poles with an ultimate loading less than 100%, the following equation can be adopted:

M_o = (% loading) x M_o(max)

However, it would be prudent to design the associated foundation for the nominated M_o(max) to ensure future site upgrades can be accommodated..

Similarly, if a new pole adopts a SRF = 0.9, it is recommended that the associated foundation be designed for loads corresponding to a SRF = 1.0, i.e. increase the M_o(max) by 1.11 for the foundation design. This allows for the future maximum utilization of the pole strength.

Pole Strength and Stiffness values below GL

Tables 3 to 6 provide 'below ground' design bending moment strength and design shear strengths for current and superseded pole sizes.

Tables 7 and 8 provide 'below ground' stiffness (EI) values for current and superseded pole sizes.

The design shear strength ($ØV_u$) values are based on V_u as determined by Rocla design methods using Ø = 0.9.

F3 and F5 Footing Sections

'F3 Footing Sections' and 'F5 Footing Sections' are special types of direct embedded footing sections that allow a stronger pole to replace a weaker pole at some stage in the future.

The 'F3' Footing Section could be installed with an SR2 pole but be replaced with an SR3 pole.

The 'F5' Footing Section allows an SR4 pole to be replaced with a SR5 pole.

The advantage of using these Footing Sections is that a pole swap-out can be undertaken without altering the existing foundation. The above ground pole section(s) can be readily removed from the Footing Section.

This type of upgrade provides extra pole strength to cope with additional and/or larger antennae.

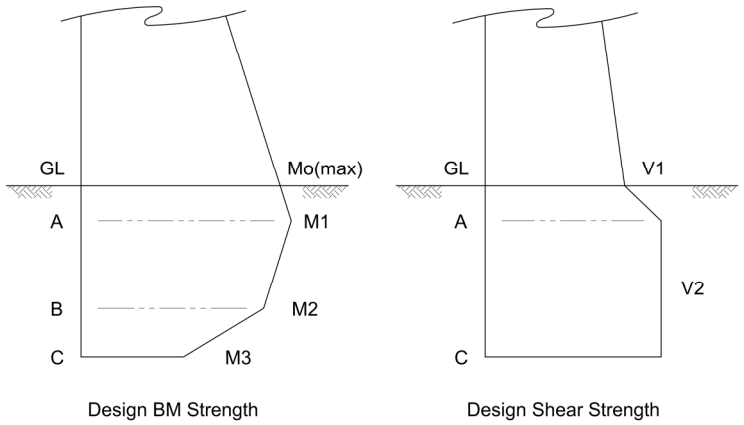
Refer to drawing 90983 for 'F3' and 'F5' Footing Sections.

Design Bending Moment and Shear Strength for LT, SR2 & SR3 Poles

Pole Type	M_s (max) (kNm)	M_o (max) (kNm)	Distance Below Ground A (m)	B (m)	C (m)	Design BM Strength M1 (kNm)	M2 (kNm)	M3 (kNm)	Design Shear Strength V1 (kN)	V2 (kN)
LT-A10	240	260	0.5	1.7	2.5	270	245	80	200	300
LT-A12	280	310	0.5	2.0	3.0	320	290	90	220	305
LT-A15	340	370	0.5	2.0	3.0	385	350	110	230	310
LT-A17	370	405	0.5	2.0	3.0	415	375	120	240	330
LT-A20	410	460	1.0	2.7	4.0	475	430	140	270	360
LT-A23	616	710	1.0	2.7	4.0	750	675	220	310	410
LT-A26	660	790	1.0	2.7	4.0	820	740	240	330	440
LT-A30	702	880	1.0	2.7	4.0	910	820	270	350	500
LT-B12	357	385	0.5	2.0	3.0	400	360	120	240	330
LT-B15	437	470	0.5	2.0	3.0	485	440	140	250	340
LT-B17	468	510	0.5	2.0	3.0	520	470	150	270	360
LT-B20	526	590	1.0	2.7	4.0	620	560	180	290	390
LT-B23	762	865	1.0	2.7	4.0	890	805	260	310	420
LT-B26	814	945	1.0	2.7	4.0	970	875	290	340	450
LT-B30	848	1,055	1.0	2.7	4.0	1,080	975	320	370	510
LT-C35	1,450	1,695	1.0	3.5	5.0	1,750	1,575	520	400	620
SR2-H15-450	599	630	0.5	2.0	3.0	650	585	190	330	430
SR2-H20-450	1,010	1,090	1.0	2.5	4.0	1,150	1,035	340	390	570
SR2-H25-540	1,282	1,400	1.0	3.0	4.5	1,465	1,320	440	520	680
SR2-H30-540	1,700	1,890	1.0	3.5	5.0	1,970	1,775	590	530	750
*SR2-H35-540**	2,112	2,400	1.0	3.5	5.0	2,500	2,250	750	580	900
*SR2-H40-540**	2,470	2,860	1.0	4.0	5.5	3,000	2,700	900	600	1,000
*SR3-H15-615**	1,718	1,765	0.5	3.5	5.0	1,905	1,715	570	470	860
*SR3-H20-615**	2,116	2,220	1.0	3.5	5.0	2,370	2,135	710	520	940
*SR3-H25-615**	2,090	2,260	1.0	3.5	5.0	2,350	2,115	700	530	1,020
*SR3-H30-615**	2,703	2,965	1.0	3.5	5.0	3,105	2,795	930	580	1,130
*SR3-H35-615**	2,820	3,150	1.0	4.5	6.0	3,230	2,910	970	620	1,140
*SR3-H40-600**	2,830	3,400	1.0	4.5	6.0	3,500	3,150	1,050	620	1,140

Table 3

**Embedded section of pole to be in-filled with concrete as per Rocla specification.*

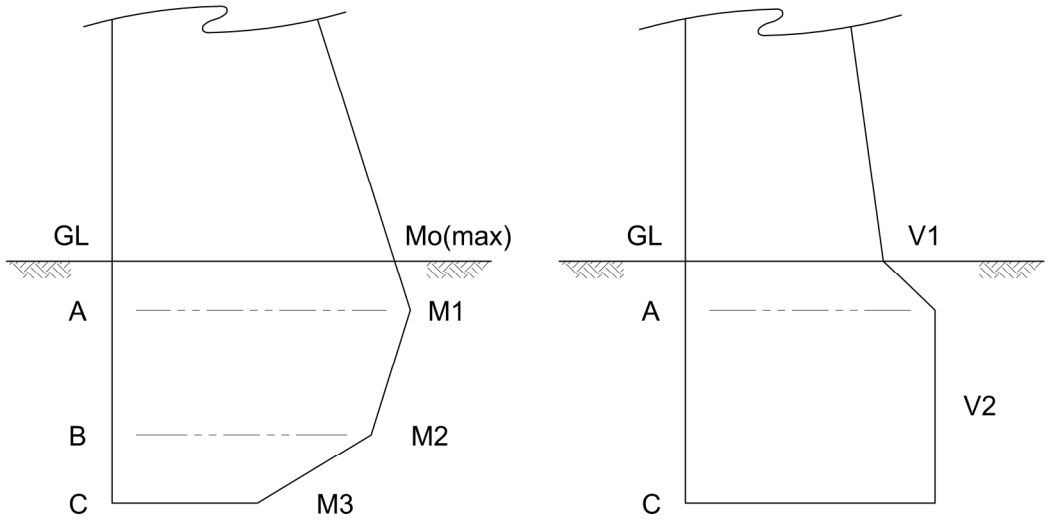


Design Bending Moment and Shear Strength for EX2 & EX3 Poles

Pole Type	M_s (max) (kNm)	M_o (max) (kNm)	Distance Below Ground A (m)	B (m)	C (m)	Design BM Strength M1 (kNm)	M2 (kNm)	M3 (kNm)	Design Shear Strength V1 (kN)	V2 (kN)
EX2-H15-525	1,010	1,090	1.0	2.5	4.0	1,150	1,035	340	390	570
EX2-H20-615	1,282	1,400	1.0	3.0	4.5	1,465	1,320	440	520	680
EX2-H25-615	1,700	1,890	1.0	3.5	5.0	1,970	1,775	590	530	750
*EX2-H30-615**	2,112	2,400	1.0	3.5	5.0	2,500	2,250	750	580	900
*EX3-H15-690**	2,116	2,220	1.0	3.5	5.0	2,370	2,135	710	520	940
*EX3-H20-690**	2,090	2,260	1.0	3.5	5.0	2,350	2,115	700	530	1,020
*EX3-H25-690**	2,703	2,960	1.0	3.5	5.0	3,105	2,795	930	580	1,130
*EX3-H25-690**	2,820	3,150	1.0	4.5	6.0	3,230	2,910	970	620	1,140

Table 4

**Embedded section of pole to be in-filled with concrete as per Rocla specifications.*



Design BM Strength

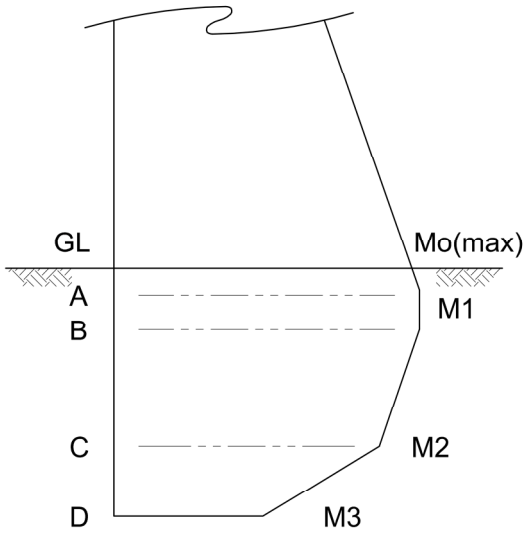
Design Shear Strength

Design Bending Moment and Shear Strength for SR4 & SR5 Poles

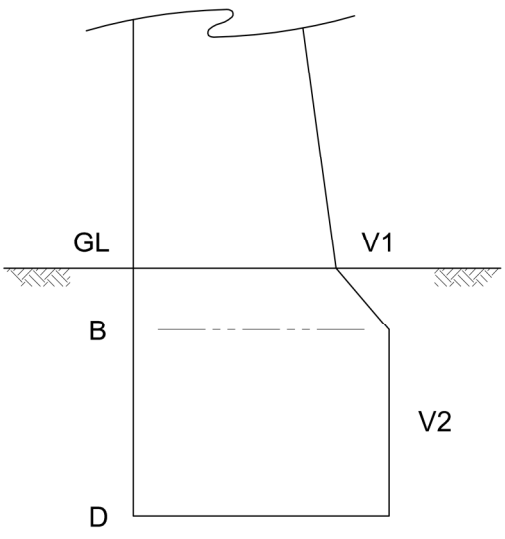
Pole Type	M_s (max) (kNm)	M_o (max) (kNm)	Distance Below Ground				Design BM Strength			Design Shear Strength	
			A (m)	B (m)	C (m)	D (m)	M1 (kNm)	M2 (kNm)	M3 (kNm)	V1 (kN)	V2 (kN)
*SR4-H15-1050**	4,155	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*SR4-H19-990**	4,120	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*SR4-H25-900**	4,035	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*SR4-H30-825**	3,940	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*SR4-H35-750**	3,810	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*SR4-H40-675**	3,670	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*SR4-H45-600**	3,495	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*SR4-H50-525**	3,315	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*SR5-H19-990**	6,870	7,010	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*SR5-H25-915**	6,870	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*SR5-H30-840**	6,680	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*SR5-H35-765**	6,470	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*SR5-H40-690**	6,140	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*SR5-H45-615**	6,000	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*SR5-H50-540**	5,690	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300

Table 5

**Embedded section of pole to be in-filled with concrete as per Rocla specifications.*



Design BM Strength



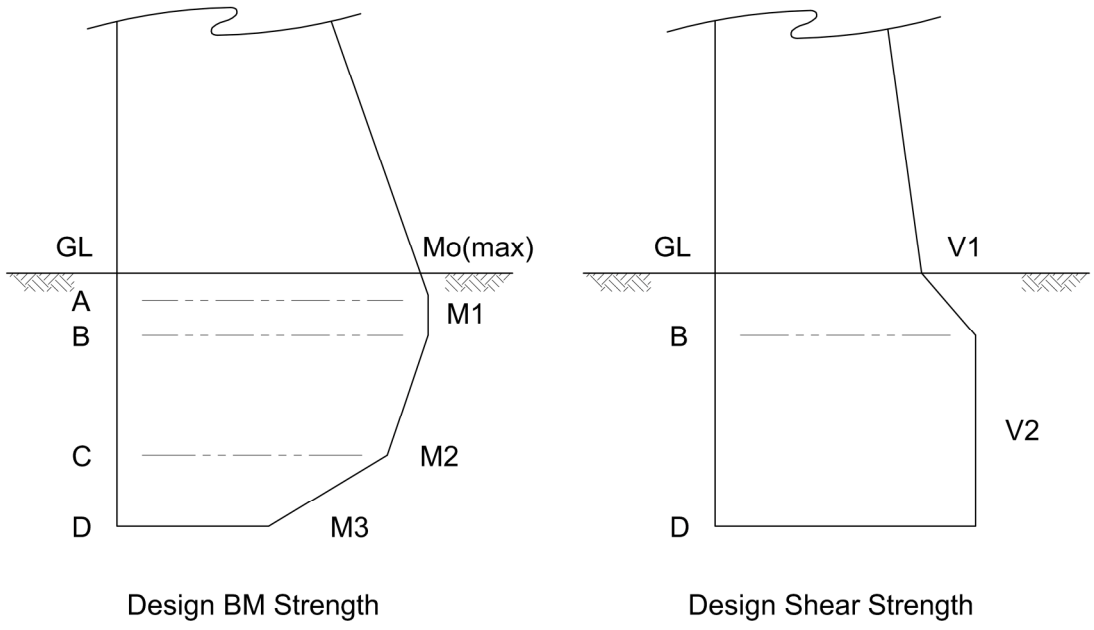
Design Shear Strength

Design Bending Moment and Shear Strength for EX4 & EX5 Poles

Pole Type	M_s (max) (kNm)	M_o (max) (kNm)	Distance Below Ground				Design BM Strength			Design Shear Strength	
			A (m)	B (m)	C (m)	D (m)	M1 (kNm)	M2 (kNm)	M3 (kNm)	V1 (kN)	V2 (kN)
*EX4-H14-1065**	4,120	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*EX4-H20-975**	4,035	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*EX4-H25-900**	3,940	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*EX4-H30-825**	3,810	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*EX4-H35-750**	3,670	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*EX4-H40-675**	3,495	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*EX4-H45-600**	3,315	4,220	0.5	1.5	5.5	7.0	4,500	4,100	1,300	710	1,200
*EX5-H14-1065**	6,870	7,010	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*EX5-H20-990**	6,870	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*EX5-H25-915**	6,680	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*EX5-H30-840**	6,470	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*EX5-H35-765**	6,140	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*EX5-H40-690**	6,000	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300
*EX5-H45-615**	5,690	7,150	1.0	2.5	7.5	9.0	7,800	6,900	2,000	710	1,300

Table 6

**Embedded section of pole to be in-filled with concrete as per Rocla specifications.*



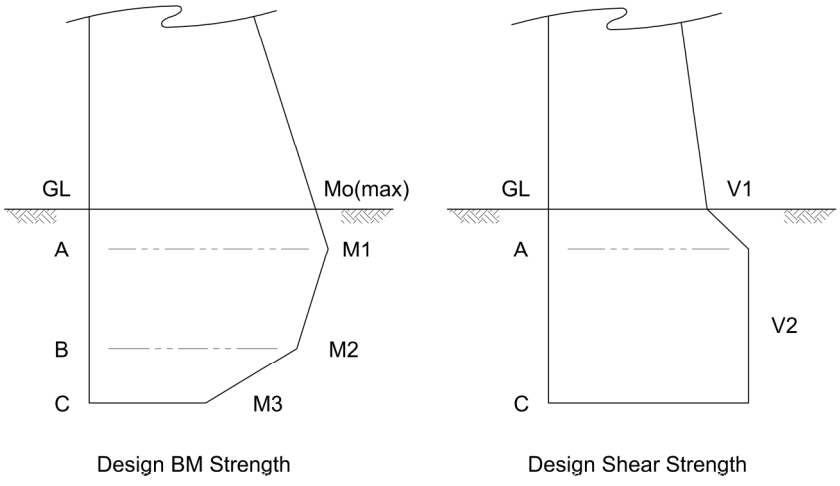
Design BM Strength

Design Shear Strength

Design Bending Moment and Shear Strength for Superseded Poles

Pole Type	Tip OD	M_s (max)	M_o (max)	Distance Below Ground			Design BM Strength			Design Shear Strength	
				A	B	C	M1	M2	M3	V1	V2
	(mm)	(kNm)	(kNm)	(m)	(m)	(m)	(kNm)	(kNm)	(kNm)	(kN)	(kN)
LTA15	315	340	370	0.5	2.0	3.0	385	350	110	230	310
LTA17	315	370	405	0.5	2.0	3.0	415	375	120	240	330
LTA20	315	410	460	1.0	2.7	4.0	475	430	140	270	360
LTA23	315	616	710	1.0	2.7	4.0	750	675	220	310	410
LTA26	315	660	790	1.0	2.7	4.0	820	740	240	330	440
LTB15	360	437	470	0.5	2.0	3.0	485	440	140	250	340
LTB17	360	468	510	0.5	2.0	3.0	520	470	150	270	360
LTB20	360	526	590	1.0	2.7	4.0	620	560	180	290	390
LTB23	360	762	865	1.0	2.7	4.0	890	805	260	310	420
LTB26	360	814	945	1.0	2.7	4.0	970	875	290	340	450
SR1-H15	450	521	550	0.5	2.0	3.0	565	510	170	300	310
SR1-H20	450	580	630	1.0	2.5	3.7	660	595	190	350	360
SR1-H20J	450	610	670	1.0	2.5	3.7	710	640	210	350	360
SR1-H25	457	796	895	1.0	3.0	4.5	950	855	280	420	580
SR1-H30	510	1,180	1,325	1.0	3.5	5.0	1,390	1,255	410	700	700
SR2-H15	450	561	590	0.5	2.0	3.0	610	550	180	360	370
SR2-H20	405	801	880	1.0	2.5	3.7	940	850	280	350	360
SR2-H25	457	1,032	1,155	1.0	3.0	4.5	1,220	1,100	360	470	530
SR2-H30J1	510	1,714	1,880	1.0	3.5	5.0	1,980	1,785	590	710	710
SR2-H30J2	525	1,788	1,965	1.0	3.5	5.0	2,065	1,860	620	710	710
SR2-H35	510	2,030	2,300	1.0	3.5	5.0	2,480	2,235	740	710	710
SR3-H15	630	1,380	1,420	0.5	2.0	3.0	1,470	1,325	440	550	560
SR3-H20	810	3,186	3,290	1.0	2.7	4.0	3,500	3,150	150	710	840
SR3-H25	705	2,836	3,005	1.0	3.5	5.0	3,200	3,880	960	710	840
SR3-H30J1	630	2,664	2,880	1.0	3.5	5.0	3,030	2,730	910	710	840
SR3-H30J2	615	2,640	2,860	1.0	3.5	5.0	3,030	2,730	910	760	760
SR3-H35	630	2,955	3,270	1.0	4.5	6.0	3,430	3,090	1,030	710	840

Table 7



Below Ground Pole Stiffness (EI) values

Pole Type	Tip OD (mm)	Total Length (m)	Embedment Depth (m)	Stiffness (EI) (Nm²)
LT-A10	315	12.5	2.5	9.14E+07
LT-A12	315	15.0	3.0	1.15E+08
LT-A15	315	18.0	3.0	1.56E+08
LT-A17	315	20.0	3.0	1.86E+08
LT-A20	315	24.0	4.0	2.50E+08
LT-A23	315	27.0	4.0	3.31E+08
LT-A26	315	30.0	4.0	4.11E+08
LT-A30	315	34.0	4.0	5.40E+08
LT-B12	360	15.0	3.0	1.54E+08
LT-B15	360	18.0	3.0	2.03E+08
LT-B17	360	20.0	3.0	2.39E+08
LT-B20	360	24.0	4.0	3.17E+08
LT-B23	360	27.0	4.0	4.09E+08
LT-B26	360	30.0	4.0	5.00E+08
LT-B30	360	34.0	4.0	6.55E+08
LT-C35	390	40.0	5.0	1.03E+09
SR2-H15-450	450	18.0	3.0	3.21E+08
SR2-H20-450	450	24.0	4.0	4.96E+08
SR2-H25-540	540	29.5	4.5	9.51E+08
SR2-H30-540	540	35.0	5.0	1.30E+09
SR2-H35-540	540	40.0	5.0	1.66E+09
SR2-H40-540	540	45.5	5.5	1.73E+09
SR3-H15-615	615	20.0	5.0	7.62E+08
SR3-H20-615	615	25.0	5.0	1.02E+09
SR3-H25-615	615	30.0	5.0	1.31E+09
SR3-H30-615	615	35.0	5.0	1.68E+09
SR3-H35-615	615	41.0	6.0	1.72E+09
SR3-H40-600	600	46.0	6.0	2.15E+09
SR4-H15-1050	1,050	22.0	7.0	2.23E+09
SR4-H19-990	990	26.0	7.0	2.27E+09
SR4-H25-900	900	32.0	7.0	2.33E+09
SR4-H30-825	825	37.0	7.0	2.38E+09
SR4-H35-750	750	42.0	7.0	2.43E+09
SR4-H40-675	675	47.0	7.0	2.48E+09
SR4-H45-600	600	52.0	7.0	2.53E+09
SR4-H50-525	525	57.0	7.0	2.63E+09
SR5-H19-990	990	28.0	9.0	2.50E+09
SR5-H25-915	915	34.0	9.0	2.56E+09
SR5-H30-840	840	39.0	9.0	2.61E+09
SR5-H35-765	765	44.0	9.0	2.65E+09
SR5-H40-690	690	49.0	9.0	2.70E+09
SR5-H45-615	615	54.0	9.0	2.75E+09
SR5-H50-540	540	59.0	9.0	2.79E+09

Table 8

Below Ground Pole Stiffness (EI) values for Superseded Poles

Pole Type	Tip OD (mm)	Total Length (m)	Embedment Depth (m)	Stiffness (EI) (Nm²)
LTA15	315	18.0	3.0	1.36E+08
LTA17	315	20.0	3.0	1.62E+08
LTA20	315	24.0	4.0	2.18E+08
LTA23	315	27.0	4.0	2.97E+08
LTA26	315	30.0	4.0	3.63E+08
LTB15	360	18.0	3.0	1.82E+08
LTB17	360	20.0	3.0	2.14E+08
LTB20	360	24.0	4.0	2.85E+08
LTB23	360	27.0	4.0	3.83E+08
LTB26	360	30.0	4.0	4.70E+08
SR1-H15	450	20.0	3.0	3.31E+08
SR1-H20	405	24.0	4.0	4.29E+08
SR1-H20J	405	27.0	4.0	4.28E+08
SR1-H25	457	30.0	4.0	1.13E+09
SR1-H30	510	34.0	4.0	2.16E+09
SR2-H15	450	40.0	5.0	3.87E+08
SR2-H20	405	18.0	3.0	4.52E+08
SR2-H25	457	24.0	4.0	1.11E+09
SR2-H30J1	510	29.5	4.5	2.22E+09
SR2-H30J2	525	35.0	5.0	2.02E+09
SR2-H35	510	40.0	5.0	2.11E+09
SR3-H15	630	45.5	5.5	1.17E+09
SR3-H20	810	20.0	5.0	2.28E+09
SR3-H25	705	25.0	5.0	2.28E+09
SR3-H30J1	630	30.0	5.0	2.28E+09
SR3-H30J2	615	35.0	5.0	1.85E+09
SR3-H35	630	41.0	6.0	2.42E+09

Table 9

Crushing Strength of Poles

Refer to document “Comm pole crushing strength” for design information and data on the crushing strength of Rocla Communication poles.

Ground Level Joints

Pole joints nominally required at ground level should be constructed clear (e.g. 50mm) of the ground surface to minimize the risk of corrosion and allow easier access to assemble the joint.

An alternative, when possible, is to join the lower sections in the horizontal and then place in the foundation hole as a single unit.

Cutting and Drilling of Poles

When there is a preference to cut a pole (for example, when reducing the pole embedment depth due to rock) or drill a pole, the structural implications should be checked and confirmed by Rocla before commencing work.

Conventional cutting methods for steel reinforced, high strength concrete can be used.

Rocla can supply a methodology document to assist in the cutting operation.

Retro-fitting Ferrules

Retro-fitting ferrules to a pole is possible but should only be done with Rocla approval.

Rocla can supply a methodology document to assist in the retro-fitting of ferrules.

Maintenance and Repair

Rocla Duraspun® poles generally require minimal maintenance. However, in the event of minor physical damage to a pole, repairs can be undertaken.

Rocla can supply methodology documents to assist in the repair of a pole.

Handling and Installation

The general requirements for lifting, handling and installing Rocla poles is provided in the "Poles & Piles Handling & Installation Guide". The following information specifically relates to Rocla Communication poles.

All pole sections are to be stored or placed on the ground using two support bearers. The supports should be located approximately [0.2 x section length] from each end. Timber is the recommended bearer material. Standard flat bearers are 100 x 100 in cross section.

Top Sections

The top sections of all jointed poles are supplied with a lifting hole. The pole section is lifted via a dedicated lifting bar passing through the lifting hole with chains or slings at each end of the lifting bar. This section can be joined and lifted with the next section provided the SWL of the bar is not exceeded.

Refer to drawing 90759 for the general lifting arrangement and various acceptable lifting bar sizes and WLL limits. The standard lifting bar is 65mm in diameter, PC8.8 with a WLL = 10t.

Lower Sections

The lower pole sections can be lifted at the lifting hole, typically located 2m below the top end. However, this is impractical for bottom sections where the top end is at or near GL.
Other lifting options, except for SR5 pole sections:

- Using a pair of 7T Lifters, each connected to diametrically opposite joint studs OR
- Using a "special purpose" lifting beam connected to 4No joint studs. Single or multiple joined sections can be lifted based on the applicable WLL.

Refer to drawing 93579 for "7T Lifter" application details.
Refer to drawing 90304 for 'SP1 lifting beam' details, suitable for joint diameters 1275, 990, 810 and 630mm.
Refer to drawing 90757 for 'SP2 lifting beam' details, suitable for joint diameters 1140, 765 and 585.
Drawing 90319 details the application and use of these 'SP lifting beams.' For each 'SP lifting beam' the maximum WLL = 18 tonnes.

SR5 Sections

For SR5 sections with a High Strength joint plate, refer to drawing 94205 for "7T Lifter" application details or drawing 93785 for "LB25HS" lifting beam application details.

Appendix A – Drawing List

Drawing Number & Latest Sheets	Description
90155 |d1|f2	Standard **LT-A** Direct-embedded Communication Poles General Assembly
93668 |c	Standard **LT-A** Base-mounted Communication Poles General Assembly
90156 |e	Standard **LT-B** Direct-embedded Communication Poles General Assembly
93669 |b	Standard **LT-B** Base-mounted Communication Poles General Assembly
91642 |a	Standard **LT-C** Direct-embedded Communication Pole General Assembly
93675 |b	Standard **LT-C** Base-mounted Communication Pole General Assembly
90702 |f	Standard **SR2** Direct-embedded Communication Pole General Assembly
93670 |b	Standard **SR2** Base-mounted Communication Pole General Assembly
90703 |e	Standard **SR3** Direct-embedded Communication Pole General Assembly
93671 |b	Standard **SR3** Base-mounted Communication Pole General Assembly
90672 |c1|c2	Standard **SR4** Direct-embedded Communication Pole General Assembly
93672 |b1|b2	Standard **SR4** Base-mounted Communication Pole General Assembly
90945 |b1|b2	Standard **SR5** Direct-embedded Communication Pole General Assembly
93673 |b1|b2	Standard **SR5** Base-mounted Communication Pole General Assembly
90979 |a	Extendable **EX2** Communication Poles General Assembly
90980 |a	Extendable **EX3** Communication Poles General Assembly
90981 |a1|a2	Extendable **EX4** Communication Poles General Assembly
90982 |a1|a2	Extendable **EX5** Communication Poles General Assembly
93665 |f1|d2	Standard **LT-A** Hold-down Bolt Assembly Details
93676 |e1|c2	Standard **LT-B** Hold-down Bolt Assembly Details
94017 |a	Standard **LT-C** Hold-down Bolt Assembly Details
93677 |d1|b2	Standard **SR2** Hold-down Bolt Assembly Details
93678 |b1|a2	Standard **SR3** Hold-down Bolt Assembly Details
93679 |b	Standard **SR4** Hold-down Bolt Assembly Details
93680 |b	Standard **SR5** Hold-down Bolt Assembly Details
89228 |e1|e2	Lug Assembly details for Duraspun® Lug Jointed Poles
8383 |d	Jointing Spanner for Lug Type Joints
8384 |f	Joint Instructions for Duraspun® Lug Jointed Poles
90948 |c1|d2	High Strength Joint Plates
91086 |b	Jointing Spanner for High Strength Pole Joints
90759 |b1|c2	Lifting Rocla Poles via a Lifting Bar
90757 |a	Lifting Beam for 1140, 765 and 585 diameter tip ends
90304 |b	Lifting Beam for 1275, 990, 810 and 630 diameter tip ends
90319 |b1|b2	Application and Use of Lifting Beam
93785 |b1|a2	Application and Use of LB25HS Lifting Beam
94378 |a	'7T' Lifter Product Details
93579 |b1|a2	Application and Use of '7T' Lifter
94205 |a1|a2	Application and Use of '7T' Lifter with High Strength Plates
89104 |b	General Details for Pole Direct-embedded Footings
90949 |a	General Details for Collar/Embedded Footings
90749 |e	Lug Base-mounted Pole Assembly details with Foundation Stud Assemblies
92086 |d	Lug Base-mounted Pole Assembly details with Hold-down Bolt Assemblies
92303 |a	Pole-Pile General Arrangment
91112 |b1|b2|a3	Lad-Saf General Arrangement
90983 |a	'F3' and 'F5' Foundations
94068 |a	Tip Ferrule Shear Strengths - Communication Poles
90779 |b	Tip Ferrule Orientation Details

Appendix B – Superseded Drawings

Drawing Number	Description
89333	SR1 & SR2 General Assembly Antenna Poles
89602	SR2-H30-J & SR2-H20-J General Assembly
90152	SR3 General Assembly Antenna Poles